UNIVERSITY OF EDUCATION, WINNEBA
DEPARTMENT OF SCIENCE EDUCATION

PHYSICS COURSE MANUAL

COURSE INFORMATION

TITLE: Mechanics and Properties of Matter I
COURSE CODE: NPH 111
CREDITS: 2 Credit Hours
ENTRY REQUIREMENTS:
Students should have at least Grade 'D' in Physics and Elective Mathematics (WASSCE/SSCE or A-level) or its equivalent, or should have passed a Pre-University Entrance Exams.

INSTRUCTOR(S) INFORMATION

NAME: Dr. K.D. Taale, Dr. I.K. Anderson, Mr. Victor Antwi, Mr. Peter Dirkson
POSITION: Senior Lecturer, Lecturer, Lecturer, Visiting Lecturer (Holland)

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INTRODUCTION:

Physics is one of the most fundamental sciences and it is concerned with the basic principles of the Universe. It is one of the foundations on which other disciplines like astronomy, chemistry and geology are built. Physics can be broadly grouped into the following areas: Mechanics, Thermodynamics Electromagnetism, Optics, Waves and Sound, Relativity, Electronics, Atomic and Nuclear Physics, and Quantum. This course manual reflects only on Mechanics and Properties of Matter, which is concerned with the effects of forces on material objects. Mechanics is an appropriate introductory topic due to the fact that many of the basic principles and theories in it are used or applied in natural phenomena such as waves, heat transfer and the other areas in Physics. Mechanics and Properties of Matter I has a linked practical course (NPH 112). One of the aims of the practical work is to illustrate the meaning of the abstract concepts. Thus it will facilitate the understanding of these concepts. Students can also design their own experiment/practical to investigate a problem or provide a solution to a problem. This Course Manual is designed in such a way to encourage Learner centredness. Most of the readings and other learning processes would be done by the students themselves, with the Lecturer serving as a guide to the students. Lecturer centred approach in teaching and learning of Physics is paving way for the Learner centred approach.

You are therefore welcome to the course NPH 111-Mechanics and Properties of Matter I. The course has 3 main sections-Dynamics, Circular Motion and Gravitation.

It is our hope that you will find this course manual useful and appropriate and sticking to the guidelines in the COURSE SCHEDULE will help you to see Physics in general and Mechanics and Properties of Matter in particular understandable and interesting.

Basically, this manual is intended to:

- dispel the popular notion that Physics is difficult and show that Physics is useful, interesting and valuable to everyone.
- dispel the popular notion that Physics is just a collection of mathematical equations used to solve theoretical problems
- to challenge students to improve their abilities to reason, to think critically, and to solve problems
- to help students gain conceptual knowledge and understanding of the physical universe by studying the interrelationships between the concepts that are the framework of Physics and to apply mathematical tools as an aid to understanding those relationships.

NOTE: In the course schedule, all information under "Pre- Lesson Preparation" should be strictly adhered to by students. Those with asterisks (*) should be complied with.

SUBJECT CONTENT:

NPH 111 Mechanics & Properties of Matter I

Dynamics –

Dimensions and its applications, scalars and vectors, motion in a straight line, speed and velocity, distance-time and velocity-time graphs, area between V-T and T-Axis, acceleration, distance travelled with uniform acceleration, equations of motions, motion under gravity, projectile motion, relative velocity and acceleration, force, Newton Laws of Motion, weight, momentum, conservation of linear momentum and principle of conservation of linear momentum, elastic and inelastic collision, coefficient of restitution, rocket, motion of centre of mass, work, power and energy, p.e. and k.e. energies, conservative forces, mass and energy;

Circular motion –

angular velocity, acceleration in a circle, centripetal forces, centrifuges, motion of a bicycle rider round circular track, motion of car (or train) round circular and banked tracks.

Gravitation –

Kepler's and Newton's laws, gravitational constant and its determination, mass and density of earth, gravitational and inertial mass,

Connection with other courses:

Mechanics and Properties of Matter is a fundamental course or a preparatory course for other courses in Physics, for example heat and thermodynamics, optics, sound and waves, electricity, electronics, atomic and nuclear physics, geology, some aspects in chemistry and biology.

LITERATURE AND MATERIALS

Compulsory study texts: Physics, by Cutnell and Johnson, 7th Edition

SUPPLEMENTARY READING(S):

i. Advanced Level Physics, By Nelkon and Parker, 5th Edition
ii. Fundamentals of Physics, By Halliday, Resnick, Walker, 6th Edition
iii. College Physics, By Serway and Faughn, 4th Edition

MATERIALS USED:

i. Physics, By Cutnell and Johnson, 7th Edition
ii. Physics Laboratory Manual, By Tyler, 5th Edition SI VERSION
iii. Graph Book
iv. Pens, pencils (HB), erasers, ruler
v. Sheets to write Quizzes

TYPE OF COURSE/ LEARNING ACTIVITIES

i. Demonstration
ii. Discussion
iii. Lecture
iv. Group Work
v. Presentations by Students

COURSE SCHEDULE
PART 1

NPH 111: Mechanics and Properties of Matter I

WK	CONTENT	LEARNING OBJECTIVES: *Student should be able to*	PRE-LESSON PREPARATION
1	Dimensions	i. state the seven fundamental quantities and their units ii.express derived quantities and units as products or quotients of fundamental quantities and units respectively	PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION (i) Reading Assignment and Preparation of Notes on the Topics under Content, Pages5-6 (ii) Conceptual Questions, Page 21, Q1-5 (iii) Problems Solving, Page 22, Q7,8,10 (ii) Student companion site http://bcs.wiley.com/he-Bcs/Books?action=index&itemId=0471663158&bcsId=3138: For self-learning.
2	Scalars and Vectors	i. differentiate between scalar and vector quantities. and give examples ii. distinguish between a vector and same vector multiplied by negative one. iii. add one vector to another or do a subtraction between two vectors iv. determine the components of a given vector v. add vectors by means of components vi. do simple calculations based on the above concepts	PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION (i) Reading Assignment and Preparation of Notes on the Topics under Content, Pages 8-20 (ii) Problems Solving, Pages 20-21, Q1,2,3,4,5,6. *Solve problems 1-5 and submit them for continuous assessment in week 2. (iii) Problems Solving, Page 22, Q7,8,10,13,14. (iv) Student companion site

WK	CONTENT	LEARNING OBJECTIVES: *Student should be able to*	PRE-LESSON PREPARATION
			http://bcs.wiley.com/he-Bcs/Books?action=index&itemId=0471663158&bcsId=3138: For self-learning.
3	Motions in One Dimension- Speed, Velocity, Distance-Time and Velocity-Time graph, Area under Velocity-Time graph, Motion under Constant Acceleration , Application of Dimensions to linear motions	i. state the fundamental quantities and their units ii. express derived quantities and units as products or quotients of fundamental quantities and units respectively iii. define distance, displacement, speed, velocity, and acceleration. iv. apply the concept of dimensions to validate the units of the above physical quantities in linear motion. v.discribe and plot distance/displacement-time graph, velocity-time graph. vi. list the set of information that can be obtained from the various graphs. vii. calculate for the set of the information from the graphs.	PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION (i) Reading Assignment and Preparation of Notes on the Topics under Content, Pages 27-39, 39-51 (ii) Conceptual Questions, Page 52, Q1-5 *Discuss conceptual questions 1-5 in groups of 3 and do presentations in class in week 3 for continuous assessment. (iii) Problems Solving, Pages 52-58, Q1,3,5,7,9,21,27,30,36,67,68. (iv) Student companion site http://bcs.wiley.com/he-Bcs/Books?action=index&itemId=0471663158&bcsId=3138: For self-learning.
4/5	Equations of motion, Motion under Gravity, Projectile Motion, and Relative Velocity	i. deduce the equations of kinematics for constant acceleration by combing the concepts of displacement, velocity and acceleration. ii.apply these equations to problem-solving to determine displacement, velocity and acceleration for a moving object. iii.describe the characteristics of a freely falling body iv. apply the equations of kinematics to free-fall v.give examples of projectile motions and basic features of this type of motion vi. explain terminologies involve in projectile motions and work problems under projectile vii.compute calculations on relative velocity viii. illustrate with concrete examples the concept of relative velocity ix. do simple calculation based on projectile and relative motions x. express the above physical quantities in their dimensions.	PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION (i) Reading Assignment and Preparation of Notes on the Topics under Content, Pages 49-50 (equations of motion), Pages 65-74 (Projectile Motion), Pages 74-80 (Relative Velocity) (ii) Conceptual Questions, Page 81, Q6-10 (iii) Problems Solving, Pages 81-84, Q1,7,16,20,22, 36, 37, 40,42,45,49,53,54 Solve and submit Questions 1,7,16,20 for continuous assessment in week 4. (iv) Student companion site http://bcs.wiley.com/he-Bcs/Books?action=index&itemId=0471663158&bcsId=3138: For self-learning. *Discussions of feedback on problems and conceptual questions from week 2 to week 3 in week 4. *Short Quiz in week 5. It covers the content areas from week 1 to week 4.

WK	CONTENT	LEARNING OBJECTIVES: *Student should be able to*	PRE-LESSON PREPARATION
6/7	Newton's Laws of Motion, Weight and forces	i. describe an experiment to determine g (acceleration due to gravity) ii. define what force and mass are. iii. define the term, newton, as used in the unit of force. iv.distinguish between force and mass. v. recall that the weight of a body is equal to the product of its mass and the acceleration due to gravity, ***g***. vi. state Newton's laws of motion vii. define linear momentum in terms of mass and velocity and deduce force as the rate of change of momentum leading to the relation between force (F), mass (m) and acceleration (a) as $F = ma$. viii. outline the conditions for which $F = ma$ is applicable ix. identify force as a vector quantity and apply $F = ma$ using components x. recall that $\boldsymbol{F=ma}$ and use it in solving conceptual questions on forces. xi. integrate a free-body diagram in solving problem when applying the relation $F = ma$	PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION (i) Reading Assignment and Preparation of Notes on the Topics under Content, Pages 87-125 (Forces and Newton's Laws of Motion) (ii) Conceptual Questions, Page 125-126, Q11-15 (ii) Problems Solving, Pages 127-134, Q1,3,13,15, 34,36,45,47,49,98,102, Page 217,Q16-20, *Solve and submit problems 1,3,13 and 15 in week 7 for continuous assessment. (iv) Student companion site http://bcs.wiley.com/he-Bcs/Books?action=index&itemId=0471663158&bcsId=3138: For self-learning. Feedback on quiz 1 in week 6. *Feedback on conceptual questions and problems solving from week 5 to 6 in week 7.
8/9	Momentum, Elastic and Inelastic Collision, Motion of Centre of Mass	i..state the principle of conservation of linear momentum. ii.deduce the impulse-momentum theorem from Newton's second law of motion. iii.states the impulse-momentum theorem iv.deduce the conservation of linear momentum from impulse-momentum theorem. v.employ the principle of conservation of momentum and energy to solve problems in elastic and inelastic interactions or collisions (knowledge of the concept of coefficient of restitution is required). vi.apply the principle of conservation of momentum on the motion of rocket, ballistic pendulum, etc.	PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION Pages 196-216 (Momentum and Collisions) (ii) Conceptual Questions, Page 125-126, Q11-15 *Solve conceptual questions 11-14 and submit for continuous assessment in week 8. (ii) Problems Solving, Page 217, Q16-20, Pages 218-222, Q3,4,16,25,30,41,42 **Solve Problems (pages 218-222), Que 3,4,16,25 and submit them for continuous assessment in week 6. (iv) Student companion site http://bcs.wiley.com/he-Bcs/Books?action=index&itemId=0471663158&bcsId=3138: For self-learning.

WK	CONTENT	LEARNING OBJECTIVES: *Student should be able to*	PRE-LESSON PREPARATION
			*Discussion of feedback on problem solving and conceptual questions from week 7 to 8 in week 9 with students.
10/11	Work, Power, Energy, Conservative Forces	i.give examples of different forms of energy ii. show an understanding of the concept of work and predict situations of which work is said to be done iii.compare impulse-momentum theorem to the work-energy theorem iv.solve conceptual examples on work v.define power as work done per unit time and derive power as the product of force and velocity vi. calculate problems under power and interpret ***1 J/s=1 W*** as the unit of power vii. derive, recall and apply the formula for kinetic energy, $k.e=1/2mv^2$ from equation of motion, and the formula for potential energy, ***p.e=mgh*** from the definition of ***work= f x d*** viii. explain conservative and non-conservative forces and energy	PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION (i) Reading Assignment and Preparation of Notes on the Topics under Content, Pages 160-188 (Work and Energy), Pages 179-181(Power) (ii) Conceptual Questions, Page 188-189, Q1-5 (iii) Problems Solving, Pages 189-19, Q1,2,10,14, 35,52,60,84 (iv) Student companion site http://bcs.wiley.com/he-Bcs/Books?action=index&itemId=0471663158&bcsId=3138: For self-learning. *Short Quiz 2 in week 10. It covers content areas from week 5 to 9. *Feedback on short quiz 2 in week 11.
12	Circular Motion-angular displacement and velocity, Centripetal, Forces and Centrifuge, Motion of a bicycle rider, car, train, etc on circular track and banked track.	i.express angular displacement in radians and angular velocity in radians per second, and use these concepts to solve conceptual problems ii.use centripetal acceleration, $a=w^2r$ or $a=v^2/r$ to solve problems and derive centripetal force, $F_c=mw^2r$ or $F_c=mv^2/r$ iii.predict the principle behind the operation of centrifuge i. appraise the reason why circular tracks or curved tracks are raised i. do some conceptual calculations on a car or bicycle moving on a banked track.	PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION (i) Reading Assignment and Preparation of Notes on the Topics under Content, Pages 223-241 (Angular displacement and velocity, acceleration), Pages 135-144 (Circular Motion, Centripetal force), Pages 156-158 (Centrifuge) (ii) Conceptual Questions, Page 241-242, Q6-10 *Discuss conceptual questions 6-10 in groups of 3 and do presentations in class in week 12 for continuous assessment (iii) Problems Solving, Pages 156-158, Q11,12,18,23,27,29 (iv)Student companion site http://bcs.wiley.com/he-Bcs/Books?action=index&itemId=0471663158&bcsId=3138: For self-learning.
13	Kepler's and Newton's Laws of	i. State and relate Kepler's and Newton's laws	PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION

WK	CONTENT	LEARNING OBJECTIVES: *Student should be able to*	PRE-LESSON PREPARATION
	Universal Gravitation, Gravitational Constant and its determination.	ii. show an understanding of the concept the gravitational field iii. use Newton's law of gravitation in the form of $F=GMm/r^2$ iv. describe the experimental process of the determination of Universal Gravitational constant v. derive and solve problems using the equation $gr^2=GM$ for the gravitational field strength of a unit point mass vi. demonstrate that on the surface of the earth, g is approximately constant and is called the acceleration of free fall (acceleration due to gravity) by using a rock and a sheet of paper in the air –filled tube and the evacuated tube.	(i) Reading Assignment and Preparation of Notes on the Topics under Content, Pages 146, 273 (Kepler's Law), Pages 96-99 (Newton's Laws of Universal Gravitation) (ii) Conceptual Questions, Page 126, Q8,9,10 (iii) Problems Solving, Pages 128, Q19, 21,23,24,31,33 (iv) Student companion site http://bcs.wiley.com/he-Bcs/Books?action=index&itemId=0471663158&bcsId=3138: For self-learning. *Feedback on short quiz 2, problem solving and conceptual questions from week 10 to week 13.
14	REVISION		PHYSICS BY CUTNELL AND JOHNSON, 7TH EDITION, Page 1-359 *Discussions on short quizzes, problem solving and conceptual questions from week 1 to week 13.
15th-16th	EXAMINATION		

THEORY SESSIONS

Mondays: 6:30 am-8:30 am

PRACTICAL SESSIONS

Tuesdays: 6:30 am-9:30 am

RULES OF CONDUCT:

i. Students should be punctual.
ii. Laboratory apparel/dress (Laboratory coats, Laboratory Boots, Laboratory Goggles) should be worn.
iii. Laboratory report should be written immediately after the experiment before the student leaves the Laboratory
iv. Students should refer to UEW code of conduct for Students

ASSIGNMENTS

i. Class assignments (students are referred to the course schedule "Pre-lesson preparation")
ii. Presentations "
iii. Group Work "
iv. Quizzes "

MODE OF ASSESSMENT

i. continuous assessment (C/A)

ii. exams

Grading policies:
Continuous assessment (40%)
Assessment rules: examination (60%)

A: 80% and above	**B+:** 75%-79%	**B:** 70%-74%	**C+:** 65%-69%
C: 60%-64%	**D**+: 55%-59%	**D:** 50%-54%	**E:** Below 50%

COURSE POLICIES
Attendance: Students, who absent themselves from series of lectures (3 consecutive lectures) without any tangible reasons, would not be allowed to write the final exams. This is checked by the use "Attendance Register" in every Physics lesson.

CHEATING/PLAGIARISM:
Students are to refer to the Department of Science Education's /University of Education's Code of Conduct for students who involve themselves in cheating/plagiarism in exams and theses writing.